

REMARKS

In the Office Action of May 18, 2006, claims 15-17 and 20-24 were rejected under 35 U.S.C. 103(a) as unpatentable over Ito et al. (U.S. Patent No. 6,683,767) in view of Schutz et al. (U.S. Patent No. 5,540,520). Claims 1-14, 25 and 26 have been withdrawn and claims 18 and 19 have been cancelled.

In the present amendment, claims 15 and 22 have been amended and claims 16, 21 and 23 have been cancelled.

Applicants' invention is directed to an on-chip voltage regulator that adjusts the operating voltage of an integrated circuit to compensate for the effects of variations in the circuit fabrication process. The voltage regulator includes a voltage down-converter 18 that converts an off-chip supply voltage to an operating voltage that is supplied to the integrated circuit, a signal generator 20 for generating a signal indicative of the desired value of the operating voltage, a detector 22 for measuring at least one electrical or operational parameter of the integrated circuit when the integrated circuit is operated at a nominal voltage, and an evaluator 24 for determining the desired value of the operating voltage based on the parameter(s) measured by the detector and supplying a signal to the signal generator indicative of the desired value.

As the Examiner is aware, the '767 patent discloses a voltage down-converter (150-157) on an integrated circuit. The emphasis in the '767 patent is on the advantageous layout of the integrated circuit so as to accommodate the voltage down converters. Further, the '767 patent discloses a reference voltage generator (60,100) for specifying the desired step-down voltage. At Col. 3, lines 40-42, the '767 patent indicates that the characteristics of generator 100 are determined by trimming

information held in an electrically erasable non-volatile memory 135. The Examiner concedes that the '767 patent does not disclose a detector for measuring at least one electrical or operational parameters of the integrated circuit or an evaluator to determine the desired value of the operating voltage based on parameters measured by the detector. Indeed, the '767 patent teaches away from applicants' invention because it teaches a system in which the output voltage from the voltage down converter is specified by trimming information stored in non-volatile memory rather than by direct read out from the operating integrated circuit.

To make up for the deficiencies of the '767 patent, the Examiner relies on the '520 patent of Schutz. Schutz describes an integrated circuit 10 and an external programmable power supply 18. As noted at Col. 6, lines 31-35 of Schutz, the integrated circuit selects the supply voltage 16 (from the programmable power supply 18) based on a plurality of predetermined operational voltages and temperature of the integrated circuit device. Thus, any voltage conversion is done off-chip in the external programmable power supply 18, as its name suggests. An IC voltage control circuit 12 includes an IC temperature sensor circuit 32, a device characteristic map 34, a voltage sensor circuit 36 and a voltage control signal generator 38. There are three outputs of generator 38: slow and stop signals 40 and 42 that slow or stop the operation of IC logic 44 when the temperature or voltage of circuit 10 is near or in an inoperable or destructive range; and a voltage control signal 14 that is applied to the external programmable power supply to determine the supply voltage 16.

As stated at Col. 7, lines 1-5 of Schutz, in one embodiment, the device characteristic map 34 stores a plurality of predetermined operational voltage values

corresponding to operational temperature ranges of the integrated circuit. And, as stated at Col. 7, lines 38-45, in response to the temperature measurements, the map provides operational voltage values to the voltage control generator 38 which generates the voltage control signals 14 that are provided to the programmable power supply 18.

Contrary to the Examiner's assertion, there is no suggestion in the references for their combination. The '767 patent describes a static system. There is no way to change the output voltage of the down-converter after the circuit is programmed. The '520 patent, in contrast, is a dynamic system in which the output voltage varies with the temperature or other controlling parameter. In addition, the '767 patent describes a system with an on-chip down converter (150-157) while the '520 patent describes a system in which the output voltage is varied by the off-chip programmable power supply. Because the two systems are so different, they do not suggest their combination.

Moreover, it is not seen how the two systems could be combined. The static control of the '767 patent is in direct conflict with the dynamic control of the '520 patent and the on-chip voltage conversion of '767 patent is the exact opposite of the off-chip voltage conversion of the '520 patent. Under these circumstances, any combination of the two references inevitably must follow the teaching of applicants' invention but such hindsight reliance on applicants' teaching is prohibited.

In an effort to further distinguish applicants' invention from the references, claims 15 and 22 have been amended to specify that the integrated circuit is formed on the same chip as the voltage regulator. Since the voltage regulator includes the voltage down converter, this distinguishes the '520 patent where the programmable voltage supply is off-chip; and since the voltage regulator also includes adjustable signal generator and a

detector this distinguishes the '767 patent which does not have such elements. It should also be noted, contrary to the Examiner's remarks with respect to claims 16 and 23 at the bottom of page 3 of the Office Action, that elements 150-157 of the '767 patent are voltage down-converters and not voltage regulators.

For these reasons, claim 15 is believed to be patentable over the references cited.

Dependent claims 17 and 20 are believed patentable for the same reason claim 15 is patentable.

Independent claim 22 recites a detector that measures at least one electrical or operational parameter of a circuit of the integrated circuit and produces a measurement signal that is used to control the signal generated by the signal generator. Claim 22 is believed patentable for the same reasons claim 15 is patentable.

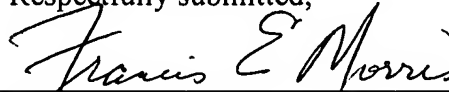
Dependent claim 24 is patentable for the same reason claim 22 is patentable.

In view of the forgoing remarks, the claims in this application are believed to be in condition for allowance. Such action is respectfully requested. If the Examiner believes a telephone interview would expedite prosecution of this application, she is invited to call applicants' attorney at the number given below.

No additional fees are believed to be due. However, if a fee is due, the Patent Office is authorized to charge Morgan, Lewis & Bockius LLP Deposit Account No. 50-0310 for all required fees for this reply and any further reply requiring a petition for extension of time for its timely submission. A copy of this document is enclosed for such purpose.

Date: August 17, 2006

Respectfully submitted,

A handwritten signature in cursive script, reading "Francis E. Morris", written over a horizontal line.

Francis E. Morris

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